Geology of Yucca Mountain at the Potential Repository Horizon

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RESEARCH OBJECTIVES

The objective of this study is to describe the geological setting of the potential repository horizon at Yucca Mountain, Nevada, within which high-level radioactive waste would be stored. To a large extent, geological characteristics dictate how well the potential repository would perform as a structure for isolating waste. From a safety standpoint, the geological setting determines the stability of excavated underground tunnels. In terms of potential transport of hazardous particles (principally, by means of water percolating through the mountain), the geology of the site, along with climate, determine groundwater flow characteristics (e.g., preferential flow pathways and potential fast-flow pathways).

APPROACH

An evaluation of the geology at the potential repository horizon involves the collection and synthesis of available geological data from project reports, maps and models. Data obtained from a dozen surface-based vertical boreholes, a recent bedrock geologic map and two underground exploratory tunnels define the geology of the potential repository block. A 3-D geological model based on these data has been developed for the purpose of visualizing the geometric orientation of the multiple rock layers and major faults in the Yucca Mountain area.

ACCOMPLISHMENTS

The three geological units slated to house the potential repository are the middle nonlithophysal, the lower lithophysal and the lower nonlithophysal units of the Topopah Spring Tuff, a regionally extensive pyroclastic-flow sheet. These three units are characterized by dense welding (caused by compaction and fusion of the tuffs at high temperatures) and abundant fractures. A distinguishing feature of the lower lithophysal unit is the abundance of cavities (lithophysae) formed by bubbles of volcanic gases trapped in the tuff matrix during cooling. These cavities vary in size, reaching up to a meter in diameter.

Under the 1999 repository design (Figure 1), the majority (approx. 80%) of the repository horizon would be located in the lower lithophysal unit (Tptpll). The remaining 20% of the repository would be divided almost equally between the middle nonlithophysal (Tptpmn) and the lower nonlithophysal (Tptpln) units.

Large normal-type displacement faults bound the potential repository area to the east and west (i.e., the Ghost Dance and Solitario Canyon faults, respectively). No major faults have been projected into the current repository footprint, though numerous small-offset faults (<30 meters vertical displacement), such as the Sundance fault, have been observed.

SIGNIFICANCE OF FINDINGS

Understanding the characteristics of the middle nonlithophysal, lower lithophysal and lower nonlithophysal units is vital to the construction of a potential repository. Fracture characteristics and lithophysal abundance within these units determine rock stability and the distribution of percolation flux, which has important implications for seepage into potential waste emplacement drifts and for transport of radionuclide particles.

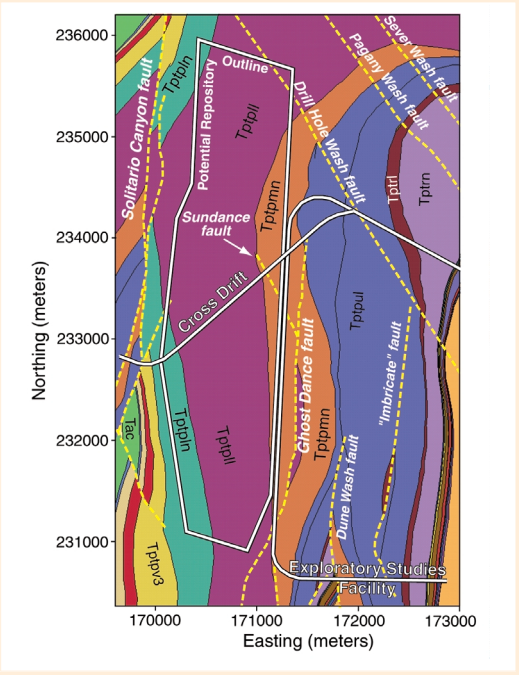

Figure 1. Geological units encountered at the potential repository horizon at Yucca Mountain.

RELATED PUBLICATIONS

Clayton, R., Geologic framework model (GFM3.1), MDL-NBS-GS-000002 REV00 ICN 01, Las Vegas, Nevada, CRWMS M&O, 2000.

Bodvarsson, G.S., et al., Unsaturated zone flow and transport model process model report (UZ PMR), Las Vegas, Nevada: CRWMS M&O, 2000.

Hinds, J., and L., Pan, Development of numerical grids for UZ flow and transport modeling, ANL-NBS-HS-000015 REV 00, Las Vegas, Nevada, CRWMS M&O, 2000.

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